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Sowjanya Gollapinni during
installation of the MicroBooNE
detector at Fermilab.

Sowjanya Gollapinni

Putting down new markers for Los Alamos neutrino research

To find answers to some of the most “massive” questions in physics posed by investigating *nearly* mass-less particles, Sowjanya Gollapinni is prepared to tackle unprecedented experimental technical challenges.

Gollapinni studies the neutrino, the second-most abundant particle in the universe—and one that “forms the most bizarre, tiny entities known to date,” she said. Neutrinos were first detected by Los Alamos researchers Fred Reines and George Cowan in 1956, and despite years of study, they “still remain largely mysterious.” These elusive particles have the potential to resolve profound science questions, including how the universe came into existence and its composition at an elemental level.

To unlock their secrets, Gollapinni (Nuclear and Particle Physics and Applications, P-3) and her colleagues employ some formidable tools, leveraging the unique resources and infrastructure provided by the Laboratory. “As the saying goes ‘the smaller the object you want to observe, the bigger and more powerful the microscope needs to be,’” she said.

These instruments include a 70-kiloton liquid argon-based particle detector, the largest of its type ever constructed, as part of DUNE (for Deep Underground Neutrino Experiment), the next-generation U.S. flagship neutrino experiment. The DUNE detector will be

“Gollapinni studies the neutrino, the second-most abundant particle in the universe—and one that ‘forms the most bizarre, tiny entities known to date.’ ”



Well, we pulled it off. With tremendous effort from our group and division administrators, and staff deployed from Finance, HR, and Property to support our division, and from all of you, we managed to start 2021 with our new group structure.

From Eric's desk . . .

“From the Desk” is a bit different this issue, coming from me instead of our division leader. This gives Tanja a little break and provides me the opportunity to give my perspective on a look back at 2020 as well as what lies ahead in 2021.

Well, we pulled it off. With tremendous effort from our group and division administrators, and staff deployed from Finance, HR, and Property to support our division, and from all of you, we managed to start 2021 with our new group structure. I hope this change has not been too disruptive to your day-to-day activities and that, despite the impediments that COVID-19 protocols put in our way, you have had the opportunity to meet and interact with your new group members. Only a few office moves have occurred so far, but more will transpire at a slow and deliberate pace over the next several months.

With the pandemic, last year was unlike any other. What I initially thought would be a few weeks of working from home has now become the norm for the last 10 months and likely to go many months more. While this work-from-home mode has been for some a stressful adjustment, particularly for those with young children and both parents working, we have largely learned to adapt and still get our important work accomplished. Thanks to all of you for figuring out how to minimize our on-site presence while remaining productive. Vaccination of the Lab's workforce is proceeding, albeit at a slower pace than we'd like due to limits on vaccine availability. Let's hope this turns the corner and that we can return to normal before year's end.

Thanks to the Herculean efforts of Celine Apodaca, Julie Canepa, Ray Leeper, Justin Jorgenson, and many others in P-4, we managed to move a good portion of the former P-24 from TA-35 to TA-53. The impetus for this move is to make space available in the Pajarito Corridor for LANL's pit production mission. While we cleared out of the second floor of Building 87, much work remains to move the light labs from the first floor into MPF-19 at TA-53. Capital Projects is undertaking the refurbishment of MPF-19 to make it suitable for moving these light labs. The design work is well under way, with modifications expected to start this month and continue through August. If things proceed smoothly, MPF-19 may be available for move-in as early as September.

On a personal note, I have decided to retire this summer after nearly 39 years with LANL. A good portion of my LANL career has been here at LANSCE and I have seen a lot of change in four decades. I started as an undergraduate student in what was then the recently-formed Accelerator Technology Division. I joined the ion source section of the group responsible for Project White Horse, which was a group pulled from Physics Division when AT Division was formed (reorganizations have been going on for a long time!). The goal was space-based missile defense using neutral beams of hydrogen atoms. At that time Los Alamos was the undisputed world leader in high-power proton accelerator technology. LANSCE and Physics Division continue to deliver cutting-edge science and technology addressing the nation's national security needs and I am pleased to have had the experience of working with all of you.

Physics Deputy Division Leader Eric Pitcher ■

Gollapinni cont.

located 1.5 miles below the surface in an abandoned gold mine in South Dakota and will receive neutrinos generated at Fermilab 800 miles away.

Leading efforts to fine tune instrumentation ...

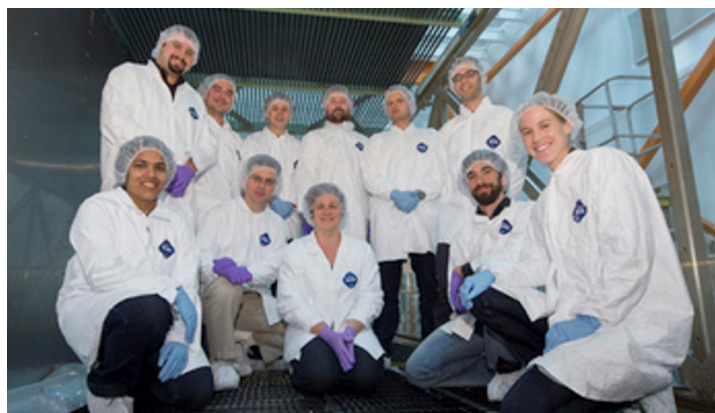
Gollapinni leads the LANL DUNE effort, serving as the technical leader of the detector's calibration and cryogenic instrumentation programs. In 2019 she received a DOE Early Career Award to aid in the development of DUNE's novel calibration system.

"By far, calibration forms one of the most challenging aspects of DUNE," she said. To help understand and diagnose any non-uniformities in the detector, Gollapinni is developing a calibration system that uses ionizing tracks from high power lasers. She is also involved in developing a system that uses a neutron generator to ultimately produce low-energy gamma particles across the large volume of the DUNE detector at energies relevant to solar neutrinos and supernovae burst physics to aid in understanding these extreme phenomena among others.

... and beyond

Gollapinni is also a member of the MicroBooNE and Short-Baseline Neutrino programs. These experiments are aimed at performing the most sensitive search of an eV-scale "sterile" neutrino, where there are numerous existing experimental anomalies. A sterile neutrino is one that does not interact with ordinary matter. Existence of sterile neutrinos will be a breakthrough discovery with a profound impact not just on particle physics, but also on astrophysics and cosmology, she said.

These projects and her efforts, part of the Lab's DOE Office of Science under the High Energy Physics (HEP) mission, attract diverse talent to LANL from across the globe and contribute to workforce development both for the Lab and the nation by developing a new



Gollapinni (front row, left) and colleagues after installing more than 8000 150-micrometer-diameter anode plane wires in MicroBooNE at Fermilab.

generation of researchers with advanced diagnostic and data analysis skills required for solving national security science challenges.

"By playing leading roles on the DUNE and Short-Baseline Neutrino programs, Sowjanya is raising the visibility of LANL neutrino science," said neutrino researcher Bill Louis (Applied and Fundamental Physics, P-2). "Through her talks at international conferences and her extensive connections with collaborators around the world, she has expanded LANL's impact in the field of neutrino physics and has brought some outstanding postdocs to the Lab."

Gollapinni, who has a PhD in physics from Wayne State University, was previously an assistant professor at the University of Tennessee, Knoxville, and she maintains an adjunct faculty position there. She joined the Lab in late 2019, drawn by its support of science investment, its rich history and pioneering neutrino work, and its collaborative research environment. "It was extremely important for me to see the Lab foster such a culture," she said. "All of this drew me to LANL."

By Karen Kippen, ALDPS ■

Sowjanya Gollapinni's favorite project

What: While all the projects I am working on are exciting in their own right, I would say DUNE is the most challenging and exciting of them all both in terms of scientific and technical potential. DUNE's liquid argon based detector will be the largest of its type ever constructed.

Why: Building a detector at such an unprecedented scale, and that too in a deep underground location, is what makes DUNE challenging. DUNE will help us understand why matter dominates over anti-matter in the universe—the question of why we exist at all.

Where and when: DUNE is scheduled to take first physics data in the late 2020s and will be located at Fermilab (near detector) and South Dakota (far detector).

Who: DUNE is an international effort and currently consists of 1000+ collaborators from more than 30 countries across the globe.

How: The large prototype detectors of DUNE, referred to as ProtoDUNEs, are running successfully at CERN in Switzerland and are a huge success toward validating the DUNE technologies.

In reach at last? Direct measurements of nuclear reactions on radionuclides

Los Alamos National Laboratory's mission is to solve national security challenges through scientific excellence. A new experimental technique being developed at the Lab for fundamental science is expected to be a boon for weapons science—a prime example of this mission at work.

Astronomers and weapons researchers share a common need that this ambitious new experiment could meet. Similar to nucleosynthesis leaving a signature of stellar evolution, the neutron fluence in a nuclear explosion leaves a unique signature that includes chains of radionuclides. In both cases, direct measurements of many—even most—of the neutron reactions are nearly impossible and understanding is empirical in nature.

A recent study aimed at uncovering the origins of heavy element production in astrophysical environments could help change that. In the just-completed experiment, Principal Investigator Hye Young Lee (Nuclear and Particle Physics and Applications, P-3) and Co-Principal Investigator Etienne Vermeulen (Inorganic, Isotope, and Actinide Chemistry, C-IIAC) directly measured nuclear reactions on radionuclides. The work represents the first credible path to make direct measurements on many key radionuclides.

Radionuclides, such as radium-226, cesium-137, strontium-90, and nickel-56, are unstable atoms that emit radiation at a variety of rates (measured in half-lives). Nickel-56 is abundantly produced in supernovae (stellar explosions).

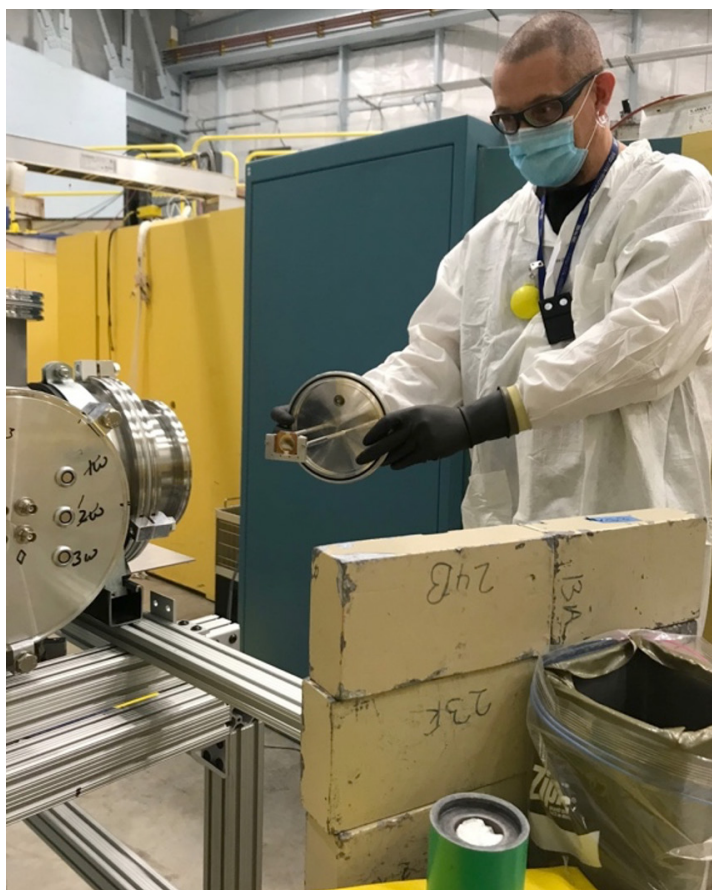
As part of the Laboratory-Directed Research and Development project “Pinning down the neutrino-proton process importance in heavy element production via reaction studies on radioactive nickel-56,” the team is now analyzing data and expect to report results this spring.

In the longer term, the researchers plan to leverage the system as part of an integrated strategy aimed at generating essential weapons data—in particular, extremely difficult to measure cross sections.

“This experiment is yet another stellar example of the synergy between the Lab’s fundamental science and its national security mission,” said Physics Division Leader Tanja Pietraß. “Through basic science endeavors like this one our researchers are advancing the understanding needed to develop new diagnostic tools for ensuring the safety, security, and reliability of the nation’s nuclear deterrent.”

Simultaneous excellence in action

In the experiment conducted at the Los Alamos Neutron Science Center (LANSCE), the research team used hotLENZ, the “hot” Low-Energy Neutron-induced Charged-particle (Z) Chamber, and



In the experiment’s last test run, Etienne Vermeulen moved a radioactive sample, strontium-82, from the lead container (green cylinder) to the ALSOLENZ, the second LENZ chamber, used for this detector performance test in Weapons Neutron Research Facility flight path 15R. Here, he recreates the process using a dummy sample, shown in the orange circle foil mounted in the vacuum flange he holds.

a highly radioactive sample generated at the Isotope Production Facility (IPF).

The experiment—probing the physics in play during supernova explosions—required a combination of sophisticated science and complex operations.

For the final reaction study, the nickel-56 sample, which has a half-life of approximately six days, was fabricated in an IPF TA-48 hot cell. It was swiftly transported inside a tungsten cask to the Weapons Neutron Research (WNR) Facility, which provided the neutron energy and flux required for the study.

Using the overhead crane in flight path 90L, this cask was disassembled as a part of the fully automated sample-handling vacuum chamber, designed by research technologist Brad DiGiovine (P-3) for this final high-dose experiment. Therefore, no workers were present in the flight path while the sample was positioned out of the cask to the beam axis with high precision.

“At LANSCE, we can produce extremely high radioactivity with a short half-life, we can prepare the target, and we can get it into the

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Direct measurements cont.

neutron beam safely with enough time to measure reaction products induced by neutron interactions on this radioactive nucleus,” Lee said.

Meticulous planning and practice

Directly measuring nuclear reactions comes with harsh consequences. The detectors would be irreparably damaged after exposure to the radiation produced during the experiment.

To guarantee they would be up to the task in this one-shot experiment, Physics and Chemistry division researchers successfully executed a high-hazard operation to test the system’s performance.

The final check of the instrument’s equipment involved manually inserting a strontium-82 sample, measuring about 5 mCi and >50 R/hour on contact, into the target holder.

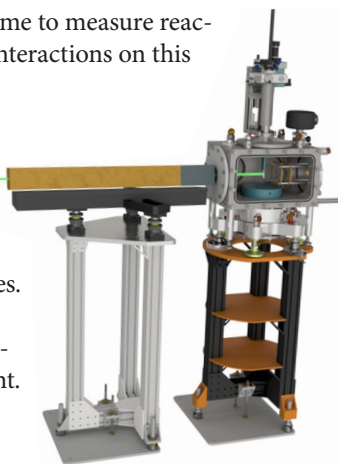
Shielding was constructed to protect Vermeulen, who was responsible for inserting the sample into the instrument vacuum chamber. In preparation of moving the target, he performed a number of handling tests. He found he preferred using radiation-resistant gloves instead of long-handled tools, as they presented less risk of puncturing the thin-foil sample and provided a surer, swifter grip.

When the time came, Vermeulen flawlessly executed the move in under five seconds, ensuring maximum safety and allowing the experiment with a relatively short-lived sample to start in the quickest possible time. “At the level where we can still do manual manipulations of sources it is imperative to be well prepared and confident in our ability to execute the work safely and precisely,” he said.

These proactive efforts—working at a lower level of radioactivity than required in the final experiment, yet at a level classified as high hazard—were important steps in anticipation of the experiment.

Researchers: Hye Young Lee, Sean Kuvin, and Brad DiGiovine (all P-3); Etienne Vermeulen, Cecilia Lledo, and Veronika Mocko (all C-IIAC). The work supports the Lab’s Basic Science mission and Nuclear and Particle Futures science pillar.

Technical contacts: Hye Young Lee, Etienne Vermeulen ■



In the illustration above, the straight green line represents a neutron beam on a sample. In the final reaction study on the Ni-56 sample, which had a factor of at least 20 times higher radioactivity than the previous one, the sample’s removal from its tungsten cask (shown as the dark blue cylinder below the sample) and its alignment in the LANSCE proton beam were handled by the hotLENZ remote sample manipulation system.

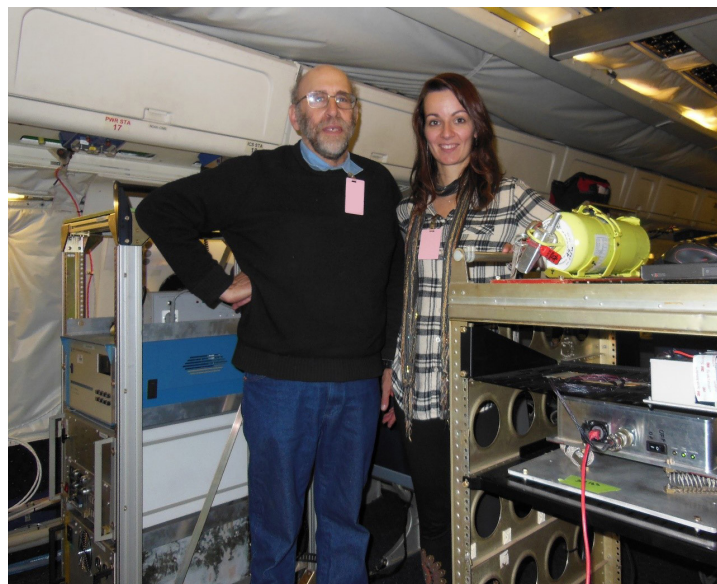
Novel thermal neutron detector safeguards aircraft, HPC semiconductor electronics

Los Alamos researchers collaborated with Honeywell, Inc. to develop the Tinman technology to detect deleterious levels of thermal neutrons.

It has long been recognized that high-energy neutrons can impact the reliability of semiconductor devices by producing ionized particles that deposit charge in semiconductor devices. There have been recent concerns that thermal neutrons can also cause failures by creating charged particles following nuclear reactions. These thermal neutrons are produced when high-energy neutrons strike moderating material and lose energy. Approximately 10–20% of single-event upsets seen in semiconductors have been attributed to thermal neutrons.

Certain environments, including high-performance computing (HPC) environments and aircraft may be particularly susceptible to thermal neutrons. In the case of HPC, there is a significant amount of cooling water near the semiconductor devices. In aircraft, there is considerable fuel in the aircraft. Both water and fuel are excellent thermalizing materials. Therefore, both industries are invested in detecting and understanding the thermal neutron environment.

Tinman does precisely that—it detects and measures thermal neutrons via He-3 tubes, one of which is covered with cadmium while the other is bare. The thermal neutron intensity is the difference in count rates between the two tubes.



Steve Wender (Applied and Fundamental Physics, P-2) (left) and Suzanne Nowicki (Space Science and Applications, ISR-1) stand in the cabin of a NASA DC-8 aircraft for testing the Tinman instrument.

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Novel cont.

Tinman is autonomous and has already been successfully tested on three different NASA aircraft flights. Tin-II is a recent advancement specifically designed for detection of thermal neutrons in the Los Alamos HPC facility. Tin-II was installed and has been operating in the HPC area for approximately one year. In addition, a version of Tinman is being designed to detect thermal neutrons as part of the Coherent Captain Mills neutrino experiment at the Los Alamos Neutron Science Center.

Research and development work is ongoing between LANL and Honeywell under a CRADA for the next-generation Tinman detector.

Tinman technology is funded by a Strategic Partnership agreement and now a CRADA with Honeywell. The technology supports the Laboratory's Nuclear Deterrence mission area and the Science of Signatures capability pillar.

Reference: S. Wender, A. Couture, and T. Fairbanks, "Report on the Tin-II thermal Neutron Detector." LA-UR 19-30822.

Technical contact: Steve Wender ■

Physics Division news roundup

Matt Durham joins leadership of LHCb experiment

Matt Durham (Nuclear and Particle Physics and Applications, P-3) has been selected as one of two ion and fixed target conveners for the Large Hadron Collider beauty (LHCb) experiment. During his roughly two-year term, which began this year, he oversees all LHCb analyses in heavy ion collisions. Durham will be the only conveyor out of 18 from the United States in the collaboration. P-3 has convenorships at two of the six operating worldwide heavy ion experiments (Durham at LHC and Cesar da Silva at the Relativistic Heavy Ion Collider [RHIC]) and major roles in the next generation of heavy ion experiments under development at RHIC and the LHC. P-3 is leading the implementation of the microvertex detector that is part of the RHIC sPHENIX experiment and is leading an upgrade detector program for LHCb.



Astrid Morreale named vice chair of APS Four Corners Section

Astrid Morreale (P-3) has been elected vice chair of the American Physical Society's Four Corners Section. As a member of its executive committee, she will help advance the section's mission to provide opportunities supporting the professional development of scientists and students in the Four Corners region of New Mexico,

Arizona, Colorado, and Utah. Her four-year term—as vice chair, chair-elect, chair, and past chair—began in November.

"As physicists we have an advantageous position to be able to reach out to both the general and specialized public thanks to the multidisciplinary predisposition of our field," Morreale said. "It is of crucial importance, especially now, that we invest within our communities to ensure that science in general has a strong presence in every household."



Morreale is a member of P-3's High Energy Nuclear Physics Team. Her research expertise encompasses hadronic/nuclear structure in a variety of collision systems and center of mass energies. After earning her PhD in 2009 in nuclear and particle physics from the University of California, Riverside, Morreale accepted a private investigator grant from the National Science Foundation to work at the Atomic Energy Commission in France. She remained in Europe for the next 10 years and received her "Habilitation thesis in physics," the highest title that can be conferred upon a scholar in France. Prior to joining the Lab in 2019, she was an associate professor at the Engineering School IMT of Nantes (France) and performed her research at the Large Hadron Collider. She is a peer reviewer for several national and international journals and a fellowship evaluator for the European Research Council, Horizon H2020 initiative. Morreale is a United States Marine Corps veteran.

Ralph Massarczyk featured in SURF article

Ralph Massarczyk (Dynamic Imaging and Radiography, P-1) was featured in a SURF news article describing the careful work done, despite COVID impacts, to swap detectors in the Majorana Demonstrator experiment. Working in a cleanroom at SURF, the Sanford Underground Research Facility in South Dakota, researchers replaced five of the original detectors with four newly made ones. The detectors are being tested for use in LEGEND-200, a next-generation neutrinoless double-beta decay experiment. Massarczyk was also recently selected to serve a one-year term on the nine-member SURF User Association's Executive Committee.



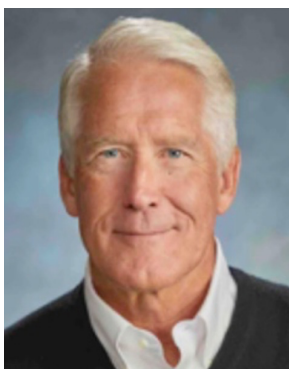
Harry Robey earns citation distinction

Harry Robey (Thermonuclear Plasma Physics, P-4) is among the top 2% of the most cited researchers worldwide throughout their careers, according to research on metascience published in *PLoS Biology*. Robey joined LANL in 2020 and is stationed at Lawrence

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Physics Division cont.

Livermore National Laboratory, where he assists and mentors P-4 personnel with the design and fielding of a wide range of high-energy-density physics experiments being conducted on the National Ignition Facility. In “Updated science-wide author databases of standardized citation indicators,” John Loannidis (Stanford University), Kevin Boyack (SciTech Strategies) and Jeroen Baas (Elsevier B.V.) present a database of the top 100,000 scientists of various disciplines.



Sowjanya Gollapinni puts her stamp on APS newsletter

Sowjanya Gollapinni (P-3) served as co-guest editor of the fall issue of the *CSWP&COM Gazette*, the newsletter of the APS committees on minorities (COM) and the status of women in physics. Chair-elect of the APS COM and chair of the indigenous physicists sub-committee, Gollapinni also contributed an article, “How to actively not be a barrier to diversity efforts in physics,” (LA-UR-20-29716) to the issue, which focused on minorities in physics.



Helium cryostat supporting DOE nuclear physics research successfully commissioned

Neutron Team Leader Takeyasu Ito (P-3) reported that a HSHV system has been successfully commissioned. The large helium cryostat will be used for studying electrical breakdown in superfluid liquid helium as part of the Lab's DOE Nuclear Physics-funded effort supporting the Spallation Neutron Source Neutron Electric Dipole Moment experiment. Postdoctoral researcher Grant Riley led this effort, with support from Wade Uhrich, Scott Currie, Nguyen Phan, Steven Clayton (all P-3), and Erick Smith (P-2). ■

Celebrating service

Congratulations to the following Physics Division employees who recently celebrated service anniversaries:

Julie Canepa, P-4	35 years
Maria Rightley, P-1	25 years
Aaron Couture, P-3	15 years
Joshua Tybo, P-1	10 years
Albert Young, P-3	10 years
Levi Neukirch, P-1	5 years
Brandon White, P-2	5 years
Jack Winkelbauer, P-3	5 years

HeadsUP!

Physics Division's commitment to the environment

The Laboratory is committed to environmental stewardship and is an ISO 14000 certified institution. A certified environmental management system enables the organization to protect the environment, mitigate adverse impacts, and assure compliance.

As part of its support of the Lab's commitment to environmental stewardship, the Physical Sciences Directorate (ALDPS) has identified environmental risks in its operations and works to reduce any environmental impact. ALDPS annually develops an environmental action plan (EAP) focused on environmental objectives of

- creating a sustainable future.
- controlling the present. and
- cleaning up the past.

Goals and targets are developed around this organizing structure in addition to complying with embedded requirements, for example waste generation controls and waste management.

Physics Division is part of the EAP and its focus for FY21 is

- helium liquification and recovery systems at the Ultracold Neutron Facility, which contributes to reducing emissions, thus creating a sustainable future,
- investment in 5S + Safety activities throughout the Division, which helps control the present, and
- helping with the site-wide cleanup program—reducing our legacy equipment and material through the clearing and disposition of multiple transportainers at TAs 35 and 53.

These projects captured in the EAP are only a subset of the good environmental awareness and work ongoing in the division.



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To submit news items or for more information, contact Karen Kippen, ALDPS Communications, at 505-606-1822 or aldps-comm@lanl.gov.

For past issues, see www.lanl.gov/org/ddste/aldps/physics/physics-flash-archive.php.



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